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**PROVISIONAL SPECIFICATION**

**25**

Invention Title: **Stopper Surface**

**30** Applicant: **PROCORK PTY LTD**  
**ACN 096 650 565**

The invention is described in the following statement:

### Stopper Surface

### Field of the Invention

5

The present invention relates to improved container stoppers for stoppering openings in containers. The stoppers are particularly useful as stoppers for openings in containers of fluids such as wine bottles, for example. The invention also relates to an improved method of producing container  
10 stoppers such as the container stoppers of the invention and packaged products, particularly packaged fluid products, in which a stopper of the invention is incorporated.

### Background of the Invention

A number of products are packaged in containers where the openings in  
15 the container are sealed using a stopper. In these circumstances, it is typical that the stopper forms an interference fit with the opening of the container. Whilst a number of products are packaged in this way, one of the most common products to be packaged using stoppers is wine.

Traditionally wine has been stored in bottles sealed with cork stoppers.  
20 Cork stoppers have been used in the wine industry for a variety of reasons most of which relate to the exceptional natural qualities of the cork. By way of example cork as a material is durable, resilient, free from rotting, is permeable to gas, is predominantly waterproof, readily compressible and easy to shape into a variety of desired conformations. In many respects, therefore cork is a  
25 natural material to consider for sealing fluid in a container such as wine in a wine bottle.

There is always the danger, however, that when using a packaging material, any contaminants in the material used to form the packaging will contaminate the final product leading to a consequent drop in final product  
30 quality. This is particularly true for packaging materials for fluid products. In many instances the performance characteristics of the packaging material may not properly take into account the effect of sustained contact between the packaging material and the fluid product during storage. This is particularly noticeable with stoppers and closures as

quite often the characteristics of the material used to produce the stopper are designed to provide ease of use of the stopper during the packaging process and this may well compromise other performance characteristics of the stopper.

For example it has been observed, that the use of cork stoppers can lead to the

- 5 development of undesirable product characteristics when used to stopper a container containing a fluid product. Thus, cork can occasionally cause off flavours in wine. It is often the cause of musty or mouldy taint and sometimes the cause of off flavours due to oxidation. In 1994 the Quercus project was initiated by the European cork industry to reduce the occurrence of off flavours.
- 10 Cork producers now follow the European Cork Federation's Code of Practise to reduce taint. TCA (2,4,6 Trichloroanisole) has been identified as the cause of some musty/mouldy taint. Although cork is not the only source of TCA in wine it has been shown that some corks contain levels of TCA which are transferred to wine when stored in bottles. It has also been observed that the taints can be
- 15 transferred to the wine via the vapour when the bottles are left standing up and the liquid does not contact the cork surface. This is due to corks poor barrier to volatile materials, demonstrated by its readiness to absorb and desorb moisture vapour with changes in relative humidity, its susceptibility to the entry of the volatiles which may be retained and later transferred to wine.

- 20 Another aspect to be considered is whether the product needs to be completely sealed off from the environment or whether gaseous exchange is desirable to improve the characteristics of the product. For example, with bottle storage of wine consideration of the flavour development of the wine with aging has to be taken into account. The concept of bottle aging, bottle maturation or
- 25 bottle development is well known, however, little is understood or scientifically proven in this area. There is some belief that the stopper breathes and that oxygen plays a role in bottle development of the wine, although it is well proven that too much oxygen will oxidise a wine and ruin it. There is a growing body of work that is developing the use of micro-oxygenation to develop flavour and
- 30 mature wines. It may therefore be desired that stoppers for use in the wine industry be permeable to some extent to allow some oxygen to permeate the stopper and come into contact with the wine.

A number of approaches have been developed aimed at overcoming the problems of contamination of the product by the stopper whilst at the same time retaining the oxygen permeability characteristic. For example it has been shown that coatings can be used to improve the performance of cork stoppers.

- 5   Waxes and paraffins may be used as coating and applied to corks to improve the sealing capability for example. If this is done paraffins are usually used in solid, oil or emulsion form. It has been observed that wax coatings also reduce the amount of liquid that soaks into the cork over time. Silicone coatings have also been applied to corks to improve the insertion and extraction of the cork. It
- 10   is thought that the silicone reduces the friction between the cork and the bottle during both the insertion and extraction processes. Coatings of this type are typically applied to the corks while the corks are tumbling in a rotating drum. The corks may be tumbled with a solid wax block or a liquid is squirted or otherwise sprayed onto corks. The coating is then spread from cork to cork by
- 15   the physical contact between the corks transferring the coating and evenly distributing it. Heat may also be applied to aid the process.

There have been several attempts to place other forms of physical barriers between the stopper and the wine to prevent the transmission of tainting components to the wine. Many of these attempts have worked on the principle of applying a coating layer on the end of the stopper in the form of a coating that is allowed to cure and dry or in the form of a polymeric film attached to the end of the stopper. Unfortunately, the characteristics of the stoppers produced using these techniques has been unsatisfactory. Without wishing to be bound by theory it is thought that the problem with these approaches is that whilst the stopper is compressible (as required for insertion into the neck of the bottle) the coating layer is typically not compressible. This leads to the development of imperfections in the coating layer such as cracking, peeling, creasing and the like. Patent application WO 00/34140 purports to overcome these problems and describes a composite stopper with a body and a thick moulded elastomer plug comprising the end of the stopper in contact with the wine. The elastomer plug provides seal to the bottle and is claimed to be a taint barrier. The difficulty with this approach is that whilst it may overcome the taint problems it creates further problems. As a starting point the unit cost of each stopper is significantly

higher than the unit cost of cork stoppers in general and so is undesirable from an economic standpoint. In addition elastomer plugs of the type described in this patent have a high transmission rate for oxygen typically meaning that the use of a plug of this type would not be expected to reduce the oxidation of the  
5 wine occurring. In addition as the exact orientation of the stopper into the opening of the container is crucial for the performance of the stopper and expensive capping machinery is required which slows production rates in order to ensure adequate performance of the stopper once fitted.

It would therefore be desirable to provide stoppers for containers that  
10 overcome or substantially ameliorate the problems associated with contamination of the contents of the container by the materials from which the stopper is made whilst preferably still allowing for oxygen transmission through the stopper.

The inventor of the present application have made a study of the prior art  
15 stoppers and have found that most of the deficiencies observed with the prior art coating techniques were caused by the radial compression of the stopper during insertion into an opening of a container. It was found that if the deformation of the film could be reduced, then the problems associated with the use of such coating films could be ameliorated. One method of achieving this is  
20 described in co-pending application PCT/AU02/00877, which employs among other features a tapering at the end of the stopper and/or the use of more uniformly compressible materials. The present invention provides alternative solutions to those disclosed in the co-pending application. In particular, the applicant has found that by ensuring the stopper has a surface finish which  
25 evens out the compression at the end of the stopper a tapered end is not required or alternatively when used in conjunction with a taper it improves the performance further. In particular the finish provides depressions such as grooves, corrugations or pits in the surface which readily compresses more uniformly and reduces wrinkling. This surface finish feature was shown to have  
30 the surprising effect of significantly improving adhesion of the coating films to the stopper beyond that expected for merely roughening the surface. A major difference between the current invention and the tapered end described in the co-application is that the surface finish allows the end face to compress fully and controls the wrinkling of the incompressible coating film into regular

patterns, while the taper of the co-invention reduces the compression of the end face thereby reducing wrinkling altogether. The benefit of using a surface finish such as described above in place of a taper is that the production costs are reduced because one less processing step is required. The benefit of using a

5      taper and a surface finish such as described above is the performance of the stopper is superior to each feature used alone although production costs will be increased.

Further in the course of studying these effects, in an attempt to produce film coated stoppers with corrugated and other surface finishes rapidly and

10     easily, the inventor created a new method of creating the finish to the stoppers while attaching the coating film. The method comprising the steps of providing a container stopper, said stopper having a body of compressible material having at least one end, said end presenting a surface; providing a film, and pressing the film and the surface relatively together whilst simultaneously heating the film

15     so as to attach the film to the surface, followed by pressing the film with a cooling plate whose surface contains a surface feature so as to shape the surface the final finish. In one aspect of this new method in some cases the film was not melted or rendered flowable during the processing, however, the stopper's surface features, resembling in some ways the surface features of the

20     cooling plate, are set during the processing.

#### Summary of The Invention

The present invention contemplates stoppers formed in a variety of shapes and configurations. The stoppers are usually elongate and may have a

25     variety of cross-sectional shapes, with the cross-sectional shape typically determined by the shape of the opening the stopper is intended to seal. Most usually, however, the stopper will have a generally cylindrically shaped body. Accordingly, the end of the stopper adapted for insertion into the container opening will usually have a generally circular cross-sectional configuration and

30     may present a generally planar end surface. The end-surface of the stopper may not be entirely planar, however. For example, a peripheral edge region at the end the stopper may be tapered or chamfered, and/or the end may have a stepped configuration forming a shoulder region. The end could also conceivably have a curved or rounded surface.

In one aspect the present invention provides a container stopper comprising a body of compressible material having at least one end for insertion into an opening of a container, and a film on the end of the body of compressible material for providing a protective layer between the body of compressible material and the container contents; wherein at least a region at the end of the body of compressible material has a surface feature whereby, upon compression of the body for insertion into an opening of a container, said region compresses without substantially adversely affecting the protective layer provided by the film. There are a number of surface features at the end of the compressible material that can provide the desired performance characteristics. One way in which this can be achieved, for example, is by ensuring that the surface at the end of the compressible body of the stopper has depressions. Another way in which this can be achieved, for example, is by ensuring that the depressions in the surface at the end of the compressible body of the stopper are corrugations, grooves or pits.

In one aspect therefore the present invention provides a container stopper comprising: a body of compressible material having at least one end for insertion into an opening of a container, said body comprising a region located at one end of the body presenting a surface, and a film attached to the end of the body of compressible material for providing a protective layer between the body of compressible material and the container contents, where the finished surface with the continuous protective film includes depressions such as corrugations, grooves and/or pits; whereby upon compression of the container body for insertion into an opening of a container said region compresses without adversely affecting the protective layer provided by the film.

The invention further relates to packaged fluid products where a stopper of the invention is incorporated into the package.

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Accordingly, in yet an even further aspect the invention comprises a packaged fluid product, said packaged fluid product comprising a container having an opening, a fluid located within said container and a container stopper inserted into said opening wherein said container stopper comprises a body of

compressible material having at least one end inserted into said opening, and a film attached to the end of the body of compressible material providing a protective layer between the body of compressible material and the fluid in the container; wherein the surface at the end of the body of compressible material

5 has one or more features such that upon compression of the container body during insertion into the opening of the container said region compressed without adversely affecting the protective layer provided by the film.

In yet a further aspect the invention provides a packaged fluid product,

10 said packaged fluid product comprising, a container having an opening, a fluid located within said container and a container stopper inserted into said opening wherein said container stopper comprises a body of compressible material having a cross sectional area and at least one end inserted into said opening; and a film attached to the end of the body of compressible material providing a

15 protective layer between the body of compressible material and the fluid; wherein at least the surface at the end of the body of compressible material has corrugations, grooves and/or pits whereby upon compression of the container body during insertion into the opening said end compressed without adversely affecting the protective layer provided by the film.

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The invention also provides a preferred method of producing a container stopper with a film on at least one surface thereof which can be used to produce the container stoppers of the invention. The method comprising the steps of providing a container stopper, said stopper having a body of compressible material having at least one end, said end presenting a surface; providing a film, and pressing the film and the surface relatively together whilst simultaneously heating the film so as to attach the film to the surface followed by cooling the film using a plate with surface features such as depressions such as corrugations, grooves, pits or protrusions such as pins, steps or ridges.

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The stoppers of the invention can be used for the storage of a wide range of materials. it is preferred that the material is a fluid, particularly beverages (including wine), oils, acids, etc.

### Description of the Figures

Figure 1. This shows a side perspective cross-section view of one end of a preferred stopper of the invention.

5      Figure 2. This shows a plan view of another preferred embodiment of the stopper of the invention.

Figure 3. This shows a plan view of the end of a further preferred stopper of the invention.

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Figure 4. This shows a side perspective cross-section view of yet a further preferred stopper.

15      Figure 5. This shows the side perspective cross-section view of one part of one end of a range of preferred the stoppers of the invention.

Figure 6. A plan view of a preferred stopper of the invention.

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### Detailed Description of the Invention.

A principal requirement of a stopper for containers for the mass production of a packaged product is the ability of the stopper to withstand the conditions imposed on the stopper during manufacture of the finished product. One of the principle conditions imposed upon stoppers irrespective of the industry in which they are utilised is that the stopper is compressed at least partially prior to its insertion into an opening in a container. The stopper then typically expands once the compression force is released leading to a tight fit of the stopper in the container opening. In the wine industry for example bottling operations typically utilise high speed stoppering machines which subject the stoppers to large compression forces. Machines of this type typically utilise a number of compression jaws which tend to radially compress the closure from its normal diameter to a substantially smaller diameter, typically about one third of the original size. These machines then utilise a ram to force the closure from

the jaws of the compression machine directly into the opening of the container where the stopper attempts to expand to its original diameter, thus sealing the bottle.

As such, a feature of the stoppers of the present invention is that they

5 have a compressible body portion. It is preferred that the stopper body is of compressible material so that it can be compressed by at least 5 percent, more preferably at least 10 percent, even more preferably at least 15 percent, even more preferably at least 20 percent, most preferably at least 30 percent. A number of materials may be used in the construction of a body portion of the

10 stoppers of the invention to achieve these desired compressibility parameters. In essence, any material possessing these properties can be used. Materials that may be used in the construction of the body portion of the stopper include cork, agglomerated cork, micro-agglomerated cork. Alternatively, the stopper body may be made from a polymeric material. For example, the stopper body

15 may comprise medium density or low density, closed cell foamed plastic. Such foam plastics may comprise one or more polymers selected from the group consisting of plastic polymers, inert polymers, homopolymers, copolymers, terpolymers, thermoplastic elastomers, and thermoplastic olefins. In such applications it is preferred that the closed cell foam plastic material comprises at

20 least one polymer selected from the group consisting of polyethylenes, metallocine catalysed polyethylenes, polybutanes, polybutylenes, polyurethanes, silicones, vinyl based resins, polyesters, ethylenic acrylic copolymers, ethylene-vinyl-acetate copolymers, ethylene-methyl-acrylate copolymers, ethylene-butyl-acrylate copolymers, ethylene-propylene-rubber,

25 styrene butadiene rubber, ethylene-ethyl-acrylic copolymers, ionomers, polypropylenes, copolymers or polyporpylenes and the like. Examples of these types of materials are provided in U.S. patent 6,355,320.

As discussed above, the closure body can also be made of fibres. Fibre closure bodies are discussed in U.S. 5,665,462 and include interalia vegetable fibres such as cotton, flax, sisal, linen, cellulose and jute, and animal-derived fibres such as angora, wool, alpaca, and mixtures thereof. Synthetic fibres can also be used including cellulose acetate, cellulose triacetate, acrylics, aromines (aromatic polyamines), rayons, polyolefins (e.g. polypropylene), nylons,

polyesters, polyurethanes, terylenes, teflon and mixtures thereof. Of course, mixtures of the synthetic and/or natural fibres may also be used in certain embodiments.

The stoppers of the invention may be any of a number of shapes with the

5 shape of the stopper typically being determined by the shape of the opening it is intended to be used in. As the stopper typically forms an interference fit with the opening in the container, it is preferred that the stopper has at least one end complementary in shape to the container opening. Thus, for example, the stoppers may be rectangular, substantially cylindrical, or, indeed, any shape

10 typically found that would be complementary to an opening of a container. The stoppers may also be elongate. One important feature of the stopper of the invention is that they must have at least one end. It is this end of the stopper that is ultimately inserted into the opening in the container and forms the interference fit thus providing the stopper performance. The stoppers may have

15 more than one end and it is preferred that the stopper has two ends.

The stoppers of the present invention can be used with any container having an opening which can be sealed by a way of an interference fit with a stopper. It is preferred, however, that the container is a bottle and the stopper is shaped to fit into the opening of the bottle, namely the mouth of the bottle.

20 The stoppers of the invention have a film on the end of the body which provides a protective layer between the body of the stopper and the contents of the container once the stopper has been inserted into the container opening. A feature of the stoppers of the invention is that the surface at the end of the body compressible material has depression like features such that upon compression of the body for insertion into an opening of a container, the region compresses without substantially adversely affecting the protective layer provided by the film. There are a number of depression features which can be utilised to achieve this result.

30 One way of achieving the desired result is to create corrugations, grooves and/or pits on the surface of at least one end of the stopper. In one preferred embodiment therefore, the property of the surface of the end of the stopper that provides this result is that at least a portion of the end of the stopper has depressions being grooves and or pits on the surface of the end of the body of compressible material. These depressions may be arrayed in a

regular pattern. The pattern may be a series of annular corrugations or a criss-cross pattern or a modified criss-cross at various angles. Various patterns may be applied on various parts of the surface or the same pattern applied to various parts of the surface. For instance: near the centre the annular corrugations may

- 5 be more widely spaced than near the edge: or if the end also incorporates a taper feature as disclosed in the co-application PCT/AU02/00877, the taper may contain corrugations running down the length direction of the cork while the flat end face contains annular corrugations; or the region near the centre a criss-cross pattern may be used while near the edge a matrix of pits is used; or the
- 10 grooves or pits may vary in depth on different regions of the surface. The depressions can be arranged with a range of depths and spacing depending on the geometry of the depression, the nature of the adhesive, the nature of the film and the degree of compression anticipated. The preferred depth is in the range 0.01 mm to 10 mm, more preferably 0.05 to 5mm and more preferably
- 15 0.1 to 3mm. The preferred spacing is in the range 0.01 mm to 10 mm, more preferably 0.05 to 7mm and more preferably 0.1 to 5mm.

It is preferred that the stopper body has two ends. It is particularly preferred with the surface depression embodiment that where there are two ends, then both of the ends of the body of the compressible material have surface depressions. If this occurs, it is preferred that both ends are surface modified in the same way and to the same extent. The advantage of this is that stoppers of this type can be used in conventional corking machines which do not discriminate between the two ends of the stopper. Therefore, using stoppers with two ends with similar tapers on the ends allows the stopper to perform the desired function irrespective of the capping technique used. In addition to machining a stopper body (either before or after application of a film) to achieve the surface features discussed above, the surface features can also be achieved by attaching a layer or disc with surface features discussed above to the end of a preformed stopper to produce a composite stopper body with the fore-mentioned surface features. Whilst this technique can be utilised, it is not preferred as it is not cost-effective as these stoppers then become expensive to produce relative to the machining technique.

The improved stoppers in accordance with the invention can utilise a number of different films. The film may be a coating layer that has been applied

as a liquid and allowed to cure or a coating layer that has been sprayed on or otherwise applied to the stopper body.

It is preferred that the film is a polymeric film, preferably a multilayer polymeric film. The polymeric film preferably comprises a barrier layer and an

- 5 adhesive layer. The barrier layer preferably has a low permeability to hydrogen, oxygen and carbon dioxide and is substantially impermeable to organic molecules with molecular weights greater than 40. A number of barrier layers are known in the art that can be utilised to achieve this result. Preferably, the barrier layer comprises one or more polymers or materials selected from the
- 10 group consisting of polyethylene and copolymers thereof, polypropylene and copolymers thereof, polyethylene Terephthalate and copolymers thereof, ethylene-vinylacetate and copolymers thereof, polyvinylchloride and copolymers thereof, polydivinylchloride and copolymers thereof, polyvinylidichloride and copolymers thereof, polyvinylacetate and copolymers thereof,
- 15 ethylenevinylacetate and copolymers thereof, polyurethane and copolymers thereof, polyacrylonitrile and copolymers thereof, cellophane, surane, polyamines, polycarbonates, polystyrene and copolymers thereof, polyalkylene oxides and copolymers thereof, polyethylene oxides and copolymers thereof, cellulose, cellulose derivatives, silicon polymer or metal foils, silica coatings or
- 20 barrier polymers such as ethylene-vinyl alcohol copolymers, polyvinyl alcohol, poly divinyl chloride or polyvinyl dichloride. A preferred film comprises polyethylene. The barrier layer may be any thickness utilised in the art. it is preferred that the barrier layer is between 1 to 50 micron, preferably 2 to 40 micron, most preferably from 5 to 30 micron.

- 25 The film also preferably includes an adhesive layer. The adhesive layer may be added to the film prior to application to the stopper end by way of a spray or may be laminated onto the film. Suitable adhesive layers include those selected from the group consisting of hot melt adhesives or heat activated adhesives. Suitable adhesives therefore include ethylene vinyl acetate, polyamides, acrylics, methyl methacrylate based polymers, starch based adhesive, carbohydrate based adhesives, protein based adhesives, animal glues, rubber, silicone, epoxy, melamine-formaldehyde based, unsaturated polyesters, urea-formaldehyde resins, resorcinol, phenolic, anaerobic adhesives, urethanes including polyurethanes, polysulfides, polyvinyl and
- 30

ethylene vinyl acetates. Particularly preferred adhesives are ethylene vinyl acetate homopolymer or co-polymer.

The adhesive layer is preferably between 0.1 to 40 micron, preferably 1 to 25 micron in thickness. If a heat activated adhesive is used, it preferably has  
5 an activation temperature greater than 30°C, more preferably greater than 50°C, most preferably greater than 80°C.

In a further embodiment, the invention provides a method of producing a container stopper with surface depressions and an un wrinkled film on at least one surface thereof for protecting said surface said method comprising the  
10 steps of

- (a) providing a container stopper, said stopper having a body of compressible material having at least one end, said end presenting a surface;
- (b) providing a film, and
- 15 (c) pressing the film and the surface relatively together whilst simultaneously heating the film and axially compressing the stopper at least 0.2% so as to attach the film to the surface.
- (d) Pressing the film and the surface relatively together using a plate with surface depressions or surface protrusions while cooling the film such  
20 that the cooled film holds surface deformations and depressions relating to the surface depressions or protrusions of the plate.

Once the stopper has been provided in the desired orientation for application of a film, a film is provided. The films provided in the method step  
25 are those previously discussed. In a preferred embodiment, the film is provided as a continuous film, spooled between two film holding elements. As such, the film typically spools between these film holding elements. The film holding elements are preferably arranged so as to be able to cooperate to advance the film in either direction as required. The film holding elements are preferably  
30 arranged or oriented such that that one surface of the film is in substantially the same plane as the end of the stopper to which the film is intended to be attached. It is preferred that the film comprises an adhesive layer and that the orientation of the film is such that the side of the film opposing the end of the stopper has the adhesive layer as an outer layer of the film.

In the process of the invention, the film and the surface are pressed relatively together whilst simultaneously heating the film so as to attach the film to the surface. There are a number of ways in which the relative pressing together of the film and the stopper can be achieved. Thus, for example, the film

- 5 can be held in place and the stopper pressed against the film. If this is the case, a backing plate is typically utilised to ensure the film does not deform away from the stopper on pressing. Alternatively, both film and die may move relative to each other to compress the stopper and film together. It is preferred, however, that the stopper is held relatively rigidly and the film pressed onto the end of the
- 10 stopper by way of a backing plate. It is preferred that the pressing is carried out with sufficient force to compress the compressible body of the stopper by at least 5 percent, preferably by at least 10 percent. The pressing step can, in theory, be carried out for any period. It is preferred, however, that it is carried out for between 0.1 to 60 seconds, more preferably 0.1 to 15 seconds, most
- 15 preferably 0.1 to 5 seconds.

In the process of the invention the film is heated during the pressing step. The heating may be achieved in a number of ways including pre-heating of the film prior to the pressing step. The heating can also be applied by heating the die or clamp holding the stopper or, alternatively, the backing plate that forces

- 20 the film on to the stopper, can be at an elevated temperature which is transferred to the film on pressing. It is preferred that the heating is such that the film is heated to a temperature to soften, melt or activate the layer closest to the closure, typically at least 40°C, preferably at least 80°C, more preferably at least 110°C.

- 25 The heating step is followed by a cooling step using a shaped plate being pressed onto the film. The surface of the plate contains surface features that correspond to the surface depressions desired in the final stopper. The plate must be pressed with sufficient force to shape the surface of the stopper. It is preferred that the pressing is carried out with sufficient force to compress
- 30 the compressible body of the stopper by at least 5 percent, preferably by at least 10 percent. The pressing step can, in theory, be carried out for any period. It is preferred, however, that it is carried out for between 0.1 to 60 seconds, more preferably 0.1 to 15 seconds, most preferably 0.1 to 5 seconds.

The process of invention can occur in such a way that only one end of the stopper is treated or, alternatively, both ends of the stopper can be simultaneously treated by the process described above. In this manner, two backing plates are utilised with two polymeric films. Upon completion of the 5 pressing step, the backing plate or plates are released so as to reduce pressure and the film advanced, a further stopper being provided and the process repeated. One way of achieving this is to have a number of dies arranged on an axle or slide wherein the axle or slide advances to a further position to present a new stopper to be treated and the treated stopper is punched out and replaced 10 with a new stopper. This allows the process to be relatively efficient and time and cost-effective and can therefore be run as a continuous process.

We now describe the invention more fully by a description of the figures. The figures are illustrative only and the dimensions implied should not be taken as indicative of the size of the surface features which may be of the order 15 0.1mm in size.

It should be understood, also, that the description following is illustrative only and should not be taken in any way as a restriction on the generality of the invention described above.

Referring to Fig 1 a cross section of the end of a particular stopper is 20 shown in side view. It shows the film coating, F, on a flat ended cork without a taper. The cross section shows one type of surface depression possible indicating how the depth, Y, and spacing, X, of the depression could be measured.

Referring to Fig 2, a plan view of a stopper shows the mid point of ridges 25 of an annular corrugation pattern.

Referring to Fig 3, it shows a plan view of a stopper indicating the mid point of ridges of a region, C, of criss-cross corrugations and a region, P, containing pit like depressions.

Referring to Figure 4 it shows a cross section side view of the end of a 30 stopper combining a tapered end with a surface finish with depressions.

Referring to Figures 5 A, 5 B and 5 C, they show a cross section side view of the part of an end of a stopper showing some of the possible surface depressions possible. Figure 5A shows some further dimensions that could be

used to describe the surface depressions. Z depicting a top land length and W a bottom land length.

Referring to Fig 6, it shows the plan view of a stopper combining a taper with the surface depressions.  $R_T$  shows the mid point of the ridge running down the taper and  $R_F$  shows the mid point of the ridge of the annular corrugations on the flat part of the stopper end.

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It should be understood that the Figures do not cover all the possible types and combinations of depressions and patterns. It is provided as a snap shot of a small number of forms of the invention. It will be appreciated that 10 various alterations and/or additions may be introduced into a particular construction and arrangement of parts specifically described with reference to the figures without departing from the spirit or ambit of the present invention.

DATED : 10 November, 2003

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PROCORK PTY LTD

- Coating

Fig. 1

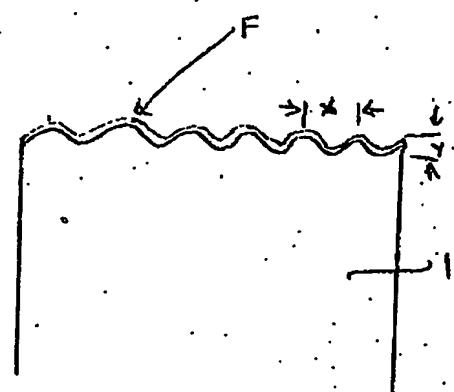


Fig. 2

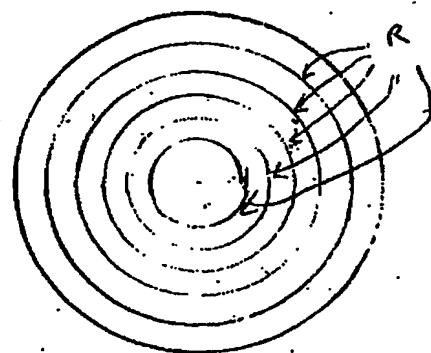


Fig. 3

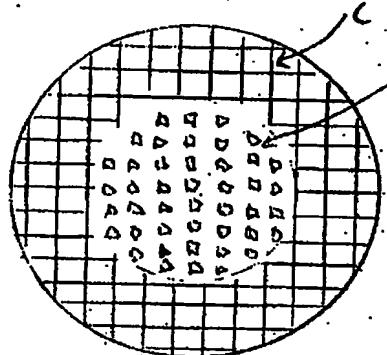


Fig. 4

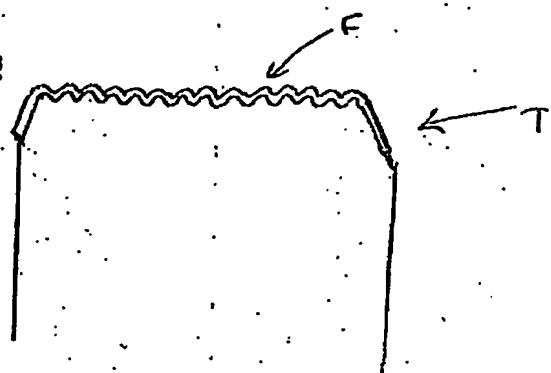


Fig. 5

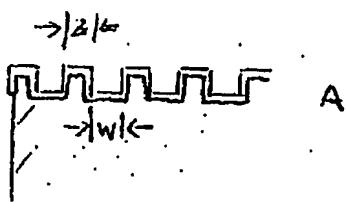
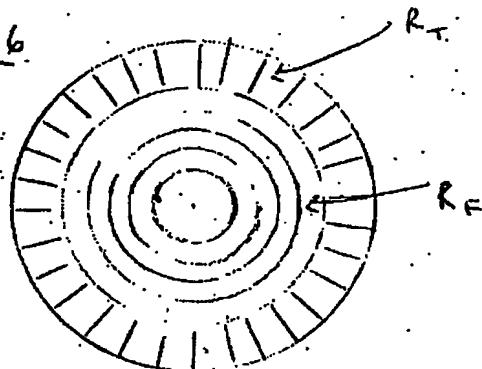


Fig. 6



B



C

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